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New data on the taxonomy, morphology and distribution of *Naarda ineffectalis* (Walker, 1859) (Lepidoptera, Erebidae, Hypeninae)

Balázs Tóth[1]

1 *Collection Lepidoptera, Hungarian Natural History Museum, Baross utca 13, HU-1088 Budapest, Hungary. toth.balazs@nhmus.hu*

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Abstract. The taxon *Naarda ineffectalis* (Walker, 1859) has had an eventful taxonomic history; in certain periods it was even synonymised with the type species of the genus. Treated recently as a species distinct from *Naarda bisignata* Walker, 1866, i.e. the type species, its female form has been hitherto unknown. In this paper the female of the species is described and the known range of it is extended by new data from Cambodia, Thailand, Japan, Korea and Sumatra. The species rank of *Naarda notata* (Hampson, 1891) is formally reinstated (stat. rev.). An identification key to the *Naarda* species of Korea and main islands of Japan is also given. With 21 figures.

Introduction

The genus *Naarda* Walker, 1866 (type species: *Naarda bisignata* Walker, 1866) consists of small, slender-bodied moths with straight and porrect labial palps. They are generally of greyish or brownish ground colour, with yellow reniform and orbicular stigmata on the forewings and have very diverse genitalia in both sexes (Tóth and Ronkay 2014a). Currently it contains 108 mainly tropical species distributed in the Old World; the number of known extant species has been doubled in the last four years due to thorough checking of preserved material by Tóth and Ronkay (2014a, 2014b, 2015a, 2015b, 2015c) within the framework of a worldwide revision, which is in progress.

Naarda ineffectalis was described on the basis of a single specimen by Walker (1859) in the genus *Hypena* Schrank, 1802. Later in the 19th century this specimen was referred to as a male being "in very bad condition" (Hampson 1893). Soon after this, the interpretation of this taxon was changed: the type species *Naarda bisignata* Walker, 1866, as well as the taxa *Cerynea laufellalis* Walker, 1859 and *Hypena notata* Hampson, 1891, were treated as synonyms of *Hypena ineffectalis* by Hampson (1895). As a consequence of this synonymisation the genus *Naarda* was merged into *Hypena*.

Subsequently, Prout (1928), describing the taxon *N. nodariodes*, underlined several structural differences between the genera *Hypena* and *Naarda* and retained *Naarda* as a valid genus. As she did not change the status of any of aforementioned species, *N. ineffectalis* became regarded as the type species of *Naarda*.

The interpretation of these taxa remained unchanged until it was modified eighty years later by Holloway (2008), who formally restored the species rank of *N. bisignata* and *N. laufellalis* with detailed justification, but synonymised *N. ochreistigma* (Hampson, 1893) with *N. ineffectalis*.

He treated *N. notata* as a good species in the description of one of his new taxa but did not explicitly state its revised status. In accordance with his statement about the difficulties of matching conspecific different sexes in the genus *Naarda*, Holloway did not describe the female of *N. ineffectalis*.

The aim of the present publication is (1) to stabilise the taxonomic concept of *N. ineffectalis* by describing its female and formally separating it from *N. notata* based on conspicuous morphological differences, (2) to provide new data concerning the distribution of *N. ineffectalis* and (3) in the light of recent discoveries, to publish a key on the temperate Pacific *Naarda* species.

Material and methods

Pinned, dry material was checked in the collections of the institutions and individual collectors listed below. Permanent microscopic slides were prepared to study the genitalia where it was necessary to facilitate identification. The conventional method was used, i.e. maceration in KOH, staining with Eosine and mounting in Euparal. The specimens and genital slides were photographed with various cameras, and the images were adjusted with the program ADOBE PHOTOSHOP CS2. Terminology follows Diakonoff (1954).

Acronyms

HNHM	Hungarian Natural History Museum, Budapest
MF	The private collection of Michael Fibiger (ZMUC)
MU	Mokpo University, Mokpo, South Korea
NHMUK	The Natural History Museum (formerly the British Museum; Natural History), London
OP	The private collection of Oleg Pekarsky, Budapest
ZMUC	Zoological Museum of the University of Copenhagen

Systematic part

Naarda ineffectalis (Walker, 1859)

Hypena ineffectalis Walker, 1859 – *List of specimens of lepidopterous insects in the Collection of the British Museum* 16: 85. Type locality: Ceylon [= Sri Lanka]. Holotype, coll. NHMUK.

Ptyophora ochreistigma Hampson, 1893 – *Illustrations of typical specimens of Lepidoptera Heterocera in the Collection of the British Museum* 2: 124. Type locality: Nawalapitya, Ceylon [= Sri Lanka]. Holotype, coll. NHMUK.

Type material examined. Holotype (Figs 1, 13). ♀ (see below): Ceylon; Abdomen missing (coll. NHMUK).

Additional material examined. Sri Lanka. 1 ♀: Colombo, viii.1908. (coll. NHMUK), 1 ♀: Colombo, 22.ii.1902. (coll. NHMUK), 1 ♀: Panquelba, i.1904. (coll. NHMUK), 1 ♀: Haputale, vi.1899 (coll. NHMUK), 1 ♀: Gampola, viii.1907; Abdomen missing (coll. NHMUK), 1 ♂: Nawalapitya; Ceylon; Coll. Green; 91.-26., slide No. BM Noct. 2812 (holotype of *Ptyophora ochreistigma*) (coll. NHMUK), 1 ♀ (Figs 2, 14): Haldumulla; xii.1909; ex. Coll. G.C. Alston; Joicey Bequest. Brit. Mus. 1934–120; slide No. RL7689♀ = BM Noct. 21618♀ (coll. NHMUK), 1 ♀: Coll. Green; 29-26; Abdomen missing (coll. NHMUK), 4 ♀: Maskeliya; January; ex. Coll. G.C. Alston.; Joicey Bequest. Brit. Mus. 1934–120, slide No. BM Noct. 2944 (coll. NHMUK), 1 ♀: data as previous specimen, but October (coll. NHMUK), 1 ♀: data as previous specimen, but March (coll. NHMUK), 1 ♀: data as previous specimen, but April (coll. NHMUK), 1 ♀: Negombo; 1973.iii.23.; leg. Hüttler B.; slide No. RL10784f (coll. HNHM).

Thailand. 1 ♀ (Fig. 3): N. Thailand, Mae Hong Son prov., Pai, 19°21.50'N, 98°26.81'E, ~500 m a.s.l., at light, 15–24.xii.2010., leg. K. Tomkovich; slide No. OP1624f (coll. OP).

Cambodia. 2 ♂, 1 ♀: Mondolkiri prov.; Seima Biodiversity Conservation Area, road Seima–O'Rang; 12°12.02'N, 107°01.98'E, 300 m; No. 117, 30.i.2006, at light; leg. G. Csorba & G. Ronkay; slide Nos TB793m, TB794f, TB813m (coll. HNHM), 2 ♂, 5 ♀: Mondolkiri prov.; Seima Biodiversity Conservation Area, road Seima–O'Rang; 12°15.73'N, 107°03.82'E, 360 m; No. 88, 27–29.i.2006, at light; leg. G. Csorba & G. Ronkay; slide Nos TB827f (Fig. 7), TB830f, TB831f, TB832m (Fig. 6) (coll. HNHM).

Japan. 1 ♀ (Fig. 5): Mifune; prov. Higo; Kyushu; 20.x.1855; A.E. Wileman; 1378; "Gnaephila" [sic, hand-written]; Wileman Coll. B.M. 1929-261; NHMUK 010914474; slide No. TB1583f (coll. NHMUK).

Korea. 1 ♂ (Fig. 4): JN: Muan, Sangma-ri; 8.vi.2006. Sei-Woong Choi; 34°55'N, 126°25'E, 55 m; slide No. TB568m (coll. MU).

Sumatra. 3 ♂: North Sumatra, Pematang Siantar, 460 m. 10–14.ii.2002. leg. M. Fibiger & K. Larsen; slide Nos TB412m, TB413m, TB421m (Figs 10, 15) (coll. MF, currently in ZMUC), 1 ♂: North-Sumatra, Hutu Padang (Asahan), River Silau, 48 km SE P. Siantar, Near Sialangoman, 220 m, 13.ii.2002. leg. M. Fibiger & K. Larsen; slide No. TB416m (coll. MF, currently in ZMUC), 1 ♀: North-Sumatra; H.W. II., 28 km S. P. Siantar; Near Tigadoluk, 1050 m; 2°45.87'N, 99°58.33'E; 4.iii.2002., leg. K. Larsen & M. Fibiger; slide No. TB649f (coll. MF, currently in ZMUC), 1 ♀: West-Sumatra, Bukittinggi, 980 m, 00°15.50'S, 100°21.22'E, 19–23.ii.2002., leg. M. Fibiger & K. Larsen; slide No. TB414f (coll. HNHM), 1 ♀: West-Sumatra, Batang Palupuh, 880 m, 7 km N. Bukittinggi, 00°14.57'S, 100°09.22'E, 21.ii.2002. leg. M. Fibiger & K. Larsen; slide No. TB681f (coll. MF, currently in ZMUC), 1 ♀: West-Sumatra, Penjabungan Tonga, 00°48.63'N, 99°34.12'E, 200 m, 18.ii.2002. leg. M. Fibiger & K. Larsen; slide No. TB418f (coll. MF, currently in ZMUC).

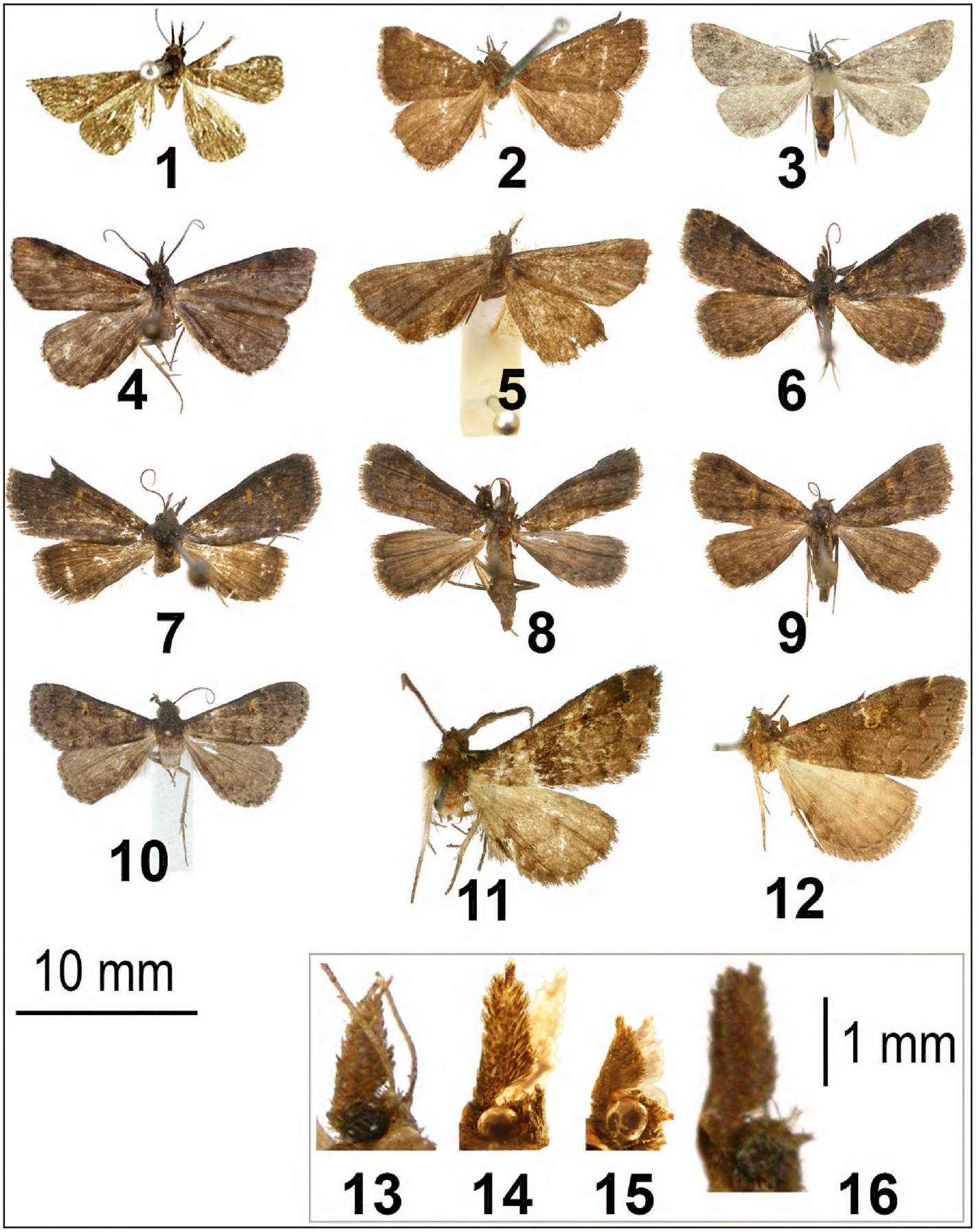
Borneo. 1 ♂, 1 ♀: Sarawak, Semongok; 12 mi. S Kuching; 26.iv.1974; at light, A. Earnshaw; slide Nos TB425m, TB544f (coll. ZMUC), 1 ♂ (Fig. 8): data as previous specimens, but 12.viii.1974 (coll. ZMUC), 2 ♂: data as previous specimen, but 24.x.1974; slide Nos TB539m, TB545m (coll. HNHM), 3 ♀: data as previous specimens, but 25.x.1974; slide Nos TB538f, TB546f (coll. ZMUC), 1 ♂: data as previous specimens, but 1.xii.1974; slide No. TB543m (coll. ZMUC), 1 ♀: data as previous specimens, but 6.xii.1974 (coll. ZMUC), 2 ♀ (Fig. 9): data as previous specimen, but 24.xii.1974; slide No. TB683f (coll. ZMUC), 1 ♀: data as previous specimens, but 1.i.1975 (coll. ZMUC).

Taxonomic comments. Holloway (2008) synonymised *N. ochreistigma* (Hampson, 1893) and *N. ineffectalis* on the basis of a topotypic male specimen from the latter taxon having the same genitalia as those of the *N. ochreistigma* holotype.

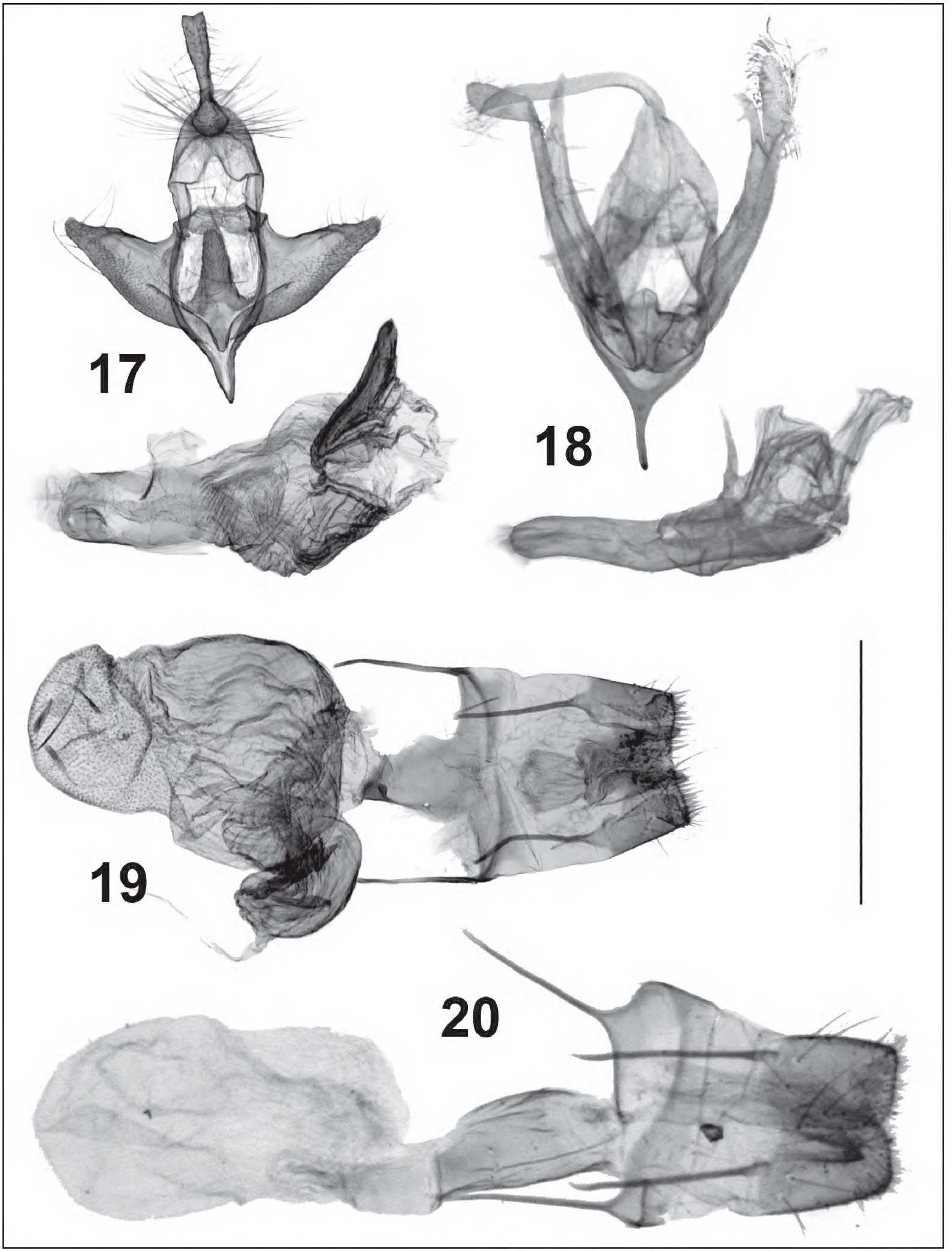
Examination of the head structure of the *N. ineffectalis* holotype specimen (Figs 1, 13) led me to the striking conclusion that it was, in contrast to Hampson (1893), actually a female. Additionally, the characters of the antenna and labial palps match well with those of *N. ochreistigma* females. These results support Holloway's synonymisation. Unfortunately the genitalia of the holotype specimen of *N. ineffectalis* cannot be studied because its abdomen is missing.

Naarda ineffectalis differs from *N. notata* in its shape of labial palps, overall size, ground colour and pattern of wings as well as in the genitalia of both sexes (Figs 1–20). These differences are detailed below, in the Diagnosis. I consider *Naarda notata* (Hampson, 1891), corroborating Holloway (2008), as a distinct species; **stat. rev.**

Description of the female. Wingspan 12–15 mm, length of forewing 6–8 mm. Antenna typical of females in the genus: filiform and sparsely ciliate, with two setae on each segment as long as the diameter of the flagellum, cilia half as long as diameter of the flagellum. Labial palps four times



Figures 1–16. 1–12. Adults. **1.** *Naarda ineffectalis* (Walker, 1859) female, holotype (coll. NHMUK). **2.** ditto, female, Sri Lanka; slide No. BM 21618♀ (coll. NHMUK). **3.** ditto, female, Thailand; slide No. OP1624f (coll. OP). **4.** ditto, male, Korea; slide No. TB568m (coll. MU). **5.** ditto, female, Japan; slide No. TB1583f (coll. NHMUK). **6.** ditto, male, Cambodia; slide No. TB832m (coll. HNHM). **7.** ditto, female, Cambodia; slide No. TB827f (coll. HNHM). **8.** ditto, male, Borneo, Sarawak (coll. ZMUC). **9.** ditto, female, Borneo, Sarawak (coll. ZMUC). **10.** ditto, male, Sumatra; slide No. TB421m (coll. MF in ZMUC). **11.** *N. notata* (Hampson, 1891), male, Sri Lanka; slide No. BM 20090♂ (coll. NHMUK). **12.** ditto, female, syntype; slide No. BM 21613 (coll. NHMUK). **13–16.** Labial palps. **13.** *N. ineffectalis* female, holotype (coll. NHMUK). **14.** ditto, female, Sumatra (coll. MF in ZMUC). **15.** ditto, male, Sumatra (coll. MF in ZMUC). **16.** *N. notata* female, syntype, Sri Lanka; slide No. BM 21613♀ (coll. NHMUK). Figures are to scale.



Figures 17–20. 17–18. Male genitalia. **17.** *N. ineffectalis*, aedeagus below: TB412m, clasping apparatus: TB416m (coll. MF in ZMUC). **18.** *N. notata*, aedeagus below; slide No. BM 20090♂ (coll. NHMUK). **19–20.** Female genitalia. **19.** *N. ineffectalis*; slide No. TB414f (coll. HNHM). **20.** *N. notata*, syntype; slide No. BM 21613♀ (coll. NHMUK). Scale bar: 1 mm. Figures are to scale.

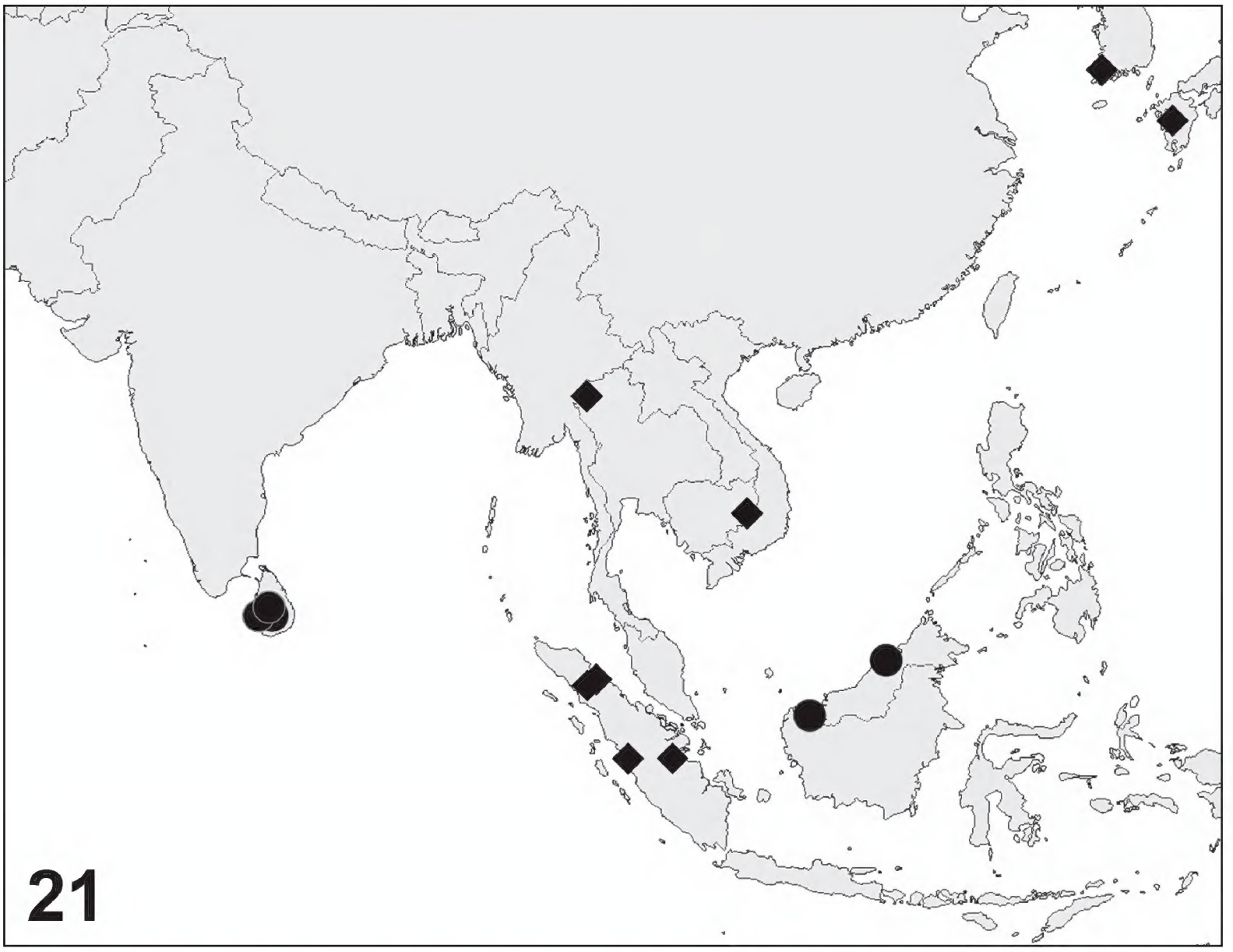


Figure 21. Distribution of *N. ineffectalis*. Previous records marked with dots, new records with diamonds.

longer than diameter of eye (longer than in male, see Figs 13–15); 3rd segment conspicuous, 2nd segment broad, domed. Scale-hood of vertex broad-based and long. Forewing brownish grey in colour; subterminal and postmedial lines parallel, slightly sinuous, the subterminal easily fading during ageing, the latter relatively broad; reniform stigma quite small, angular, elongated, pale yellow with two black dots inside, lower dot is larger than the upper one; orbicular rounded, as yellow as reniform. Hindwing slightly paler than forewing except for the area between vein Cu2 and dorsum being as dark as forewing; transverse lines like those of forewing but postmedial line often more conspicuous. Pattern of wings slightly less conspicuous in females than in males.

Female genitalia (Fig. 19). Corpus bursae ovoid, its anterior half densely covered by tiny grains, posterior half slightly wrinkled in longitudinal direction. Near the mouth of ductus bursae a broad and long, helical cervix arises. Ductus bursae smooth, broad, relatively short, nearly entirely covered by the triangular colliculum. Sternum A7 very narrow, sinus absent.

Apophyses anteriores as long as apophyses posteriores; ovipositor lobes angular.

Diagnosis. *Naarda ineffectalis* externally resembles several sympatric congeners, including *N. huettleri* Tóth & Ronkay, 2015 and *N. imitata* Tóth & Ronkay, 2015 and tends to become worn, so that dissection of genitalia is usually needed for proper identification. Characteristic features of the male genitalia (Fig. 17) are as follows: uncus with double tips, juxta large and scobinate, saccus long, valva short, triangular, aedeagus stout, cornutus very large, vesica longitudinally wrinkled

between cornutus and carina. The female genitalia of *N. ineffectalis* can be distinguished from those of all other *Naarda* species by presence of the large, helical cervix.

Compared to *N. notata* the former species has shorter and dorsally more convex labial palps; the wingspan of *N. ineffectalis* is only two-thirds of *N. notata*; the ground colour of the wings is darker, greyer, especially in the basal field; on the forewing the reniform stigma is narrower and lighter, and the transverse lines are less prominent than those of *N. notata* and *N. ineffectalis* lacks the blackish patch laterally from the reniform stigma, which is present in the other species. The hindwing of *N. ineffectalis* is only slightly lighter than the forewing while in *N. notata* the hindwing is much lighter than the forewing, and the ground colour becomes white towards the costa. In the male genitalia, the uncus of *N. ineffectalis* is slightly bifurcate, but that of *N. notata* is simple; the juxta is larger, the valva is much broader and shorter and the cornutus of aedeagus is much larger in *N. ineffectalis* than in *N. notata*. The corpus bursae in the female genitalia of *N. ineffectalis* is bigger in proportion to the whole genitalia, the cervix is much longer and the ductus bursae is shorter than those of *N. notata*.

Distribution. From Sri Lanka to Sumatra and Borneo (Sarawak and Brunei: Holloway 2008). On the Asian mainland in Cambodia and Thailand, with isolated, unusually northern, records from Japan and Korea (Fig. 21). As both latter specimens were collected near large ports, accidental introduction by transport cannot be excluded.

New for the faunas of Cambodia, Thailand, Japan, Korea and Sumatra (thus for entire Asian mainland and also for the Palaearctic Region).

Key to the *Naarda* species of Korea and main islands of Japan

1 Ground colour of reniform stigma pale yellow, lacking black dots inside, sometimes a few dark scales present: Male genitalia with completely straight valval costa and short saccular terminal extension, female genitalia with narrow ductus bursae and small corpus bursae. Russian Far East, Korea, Japan, China.....*N. maculifera* (Staudinger, 1892)

– Reniform stigma deep yellow, always containing conspicuous black dot(s) inside.....2

2 Transverse lines on all wings only slightly sinuous, not jagged (only worn specimens known): Male genitalia with long and narrow cucullus, a very strong process at tip of sacculus and conspicuous process arising from editum; female genitalia with delicate sterigma and one signum, lacking cervix. Only on Jeju Island (Korea)..... .....*N. hallasana* Tóth & Ronkay, 2015

– Transverse lines of wings sinuous and jagged at veins: Male genitalia with neither cucullus nor saccular extension nor editum. Female genitalia without sterigma, but having a large, helical cervix. Sri Lanka, Cambodia, Thailand, Korea, Japan (Kyushu), Sumatra, Borneo.....*N. ineffectalis*

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